International Journal of Agricultural Science and Research (IJASR)
ISSN(P): 2250-0057; ISSN(E): 2321-0087
Vol. 5, Issue 4, Aug 2015, 269-276


# EFFECT OF VERMICOMPOST AND *AZOTOBACTER* ON QUALITY PARAMETERS OF STRAWBERRY (*FRAGARIA* X *ANANASSA* DUCH.) CV. SWEET CHARLIE

**NEERAJ KUMAR, R. B. RAM & PRANAV KUMAR MISHRA**

Department of Applied Plant Science (Horticulture)

Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh, India

## ABSTRACT

The present study was conducted to find out the effect of vermicompost and *Azotobacter* on quality parameters of strawberry (*Fragaria* × *ananassa* Duch.) cv. Sweet Charlie during 2014-2015. Vermicompost and *Azotobacter* were applied separately and in combination at 100 q/ha and 30 ml/litre water, respectively. Different treatment combination revealed significant positive effect on most of the parameters studied under the experiment. Maximum total soluble solid (10.73 $^0$Brix), titratable acidity (0.74 %), reducing sugar (4.49 %), total sugars (6.39 %), vitamin-C (69.33 mg/100g) and vitamin-A (60.00 IU/100 g) were recorded in $T_4$. whereas; maximum TSS: acid ratio (17.05) and sugrs: acid ratio (10.15) was recorded in $T_5$. Higher contest of pectin (0.57 %) and anthocyanin (58.55 IU/100 g) were observed in treatments 4 and 5, respectively. Conclusively, $T_4$ (vermicompost 75 % + *Azotobacter* 25%) was found most effective to improve chemical parameters parameters of strawberry cv. Sweet Charlie.

**KEYWORDS:** Vermicompost, *Azotobacter*, Quality, Sweet Charlie, Strawberry

## INTRODUCTION

The cultivated strawberry *Fragaria* × *ananassa* (Duch.) is a natural hybrid of the *Fragaria chiloensis* (L.) and *Fragaria virginiana* (Duch.), is a member of the family Rosaceae, sub-family Rosoideae. Strawberry is delicious, refreshing, nutritious soft fruit with a distinct tantalizing aroma. The name "strawberry" may have derived from the practice of using straw mulch for cultivation, or it may have come from the Anglo-Saxon word strew, meaning to spread. It is the most widely distributed fruit crop due to its genotypic diversity, highly heterozygous nature and broad range of environmental adaptations (Larson, 1994; Childer *et al*., 1995). Now a day, it is commercially cultivated under the sub tropical, high altitude, tropical regions and even in desert areas. It is a herbaceous perennial plant, cherished in gardens and commercial fields (Sharma and Yamdagni, 2000), now it becomes an important table fruit as it not only tastes extremely delicious, it has nutritional value within itself, rich source of vitamins A, B, C and niacin, minerals like phosphorus, potassium, calcium and iron (Karkara and Dwivedi, 2002). Vermicompost are organic materials broken down by interactions between micro-organism and earthworms in a mesophilic process, to produce fully stabilized organic soil amendments with low C: N ratios (Ramasamy *et al.,* 2011). Vermicompost comprises considerable quantities of nutrients, huge valuable microbial population and biologically active metabolites (gibberellins, cytokinins, auxins) and vitamins B which can be applied alone or in combination with other inorganic or organic fertilizers to get better quality of crops (Atiyeh *et al.,* 2002; Arancon *et al.,* 2006). Vermicompost is responsible for maintaining fertility of soil because of minerals contained in it converted to such forms (nitrates, exchangeable phosphorous, soluble potassium, calcium, manganese etc) that could be readily taken up by plants.

The addition of vermicompost to field strawberries was found to produce significantly higher yields than the addition of equivalent amounts of mineral fertilizers, and the presence of plant growth regulators in the vermicompost was suggested (Arancon *et al.,* 2004). Vermicompost enhance the nutrient uptake by the plants by increasing the permeability of root cell membrane, stimulating root growth and increasing proliferation of root hairs (Pramanik *et al.*, 2007). Vermicompost application influences the properties (physical, chemical and biological) of soil as well as improves the water holding capacity of the soil.

*Azotobacter* is free-living aerobic bacteria dominantly found in soils. They are non-symbiotic heterotrophic bacteria capable of fixing an average 20 kg N/ha/per year. Besides, it also produces growth promoting substances. *Azotobacter* spp. are found in the soil and rhizosphere of many plants and their population ranges from negligible to 104 g-1 of soil depending upon the physico-chemical and microbiological (microbial interactions) properties. The population of *Azotobacter* spp. in soils are affected by soil physico-chemical properties (organic matter, pH, temperature, soil depth, soil moisture) and microbiological properties (microbial interactions). As far as physico-chemical soil properties are concerned, various researches have focused on the nutrients, organic matter content and their positive effect on *Azotobacter* populations in soils (Pramanix and Misra, 1955; Bescking, 1961; Jensen, 1965; Burris, 1969).

## MATERIALS AND METHODS

The experiment was carried out at Horticultural Research Farm, Babasaheb Bhimrao Ambedkar University (Latitude 260 46′7′′N and longitude 80055′38′′E, altitude of 129 m asl), Lucknow, Uttar Pradesh, India during 2014-2015. The average minimum and maximum temperature recorded between 6 $^{0}$C (December, 2014 and January, 2015) to 31$^{0}$C (March, 2015) and mean rainfall ranged between 0 to 76 mm during the cropping period. For soil analysis (Table 1), triplicate form of soil samples were collected (0-15 cm soil depth) before the treatment application from respective treatment blocks. pH and electrical conductivity (EC) of soil were measured by electrodes (Orion) using soil/double distilled water in a ratio of 1:2.5 (w/v) as filtered extract. Total organic matter and available potassium were estimated as per the method suggested by Jackson (1962) whereas, available phosphorus was measured as per the procedure given by Olsen et al. (1983) whereas; available nitrogen was determined by the approach suggested by Stanford and Smith (1978).

**Table 1: Chemical and Physical Properties of the Soil at the Beginning of the Experiment**

| Soil Properties | Result |
|---|---|
| Sand (%) | 61 |
| Silt (%) | 15 |
| Clay (%) | 11 |
| pH | 6.8 |
| Organic matter (%) | 1.6 |
| Available nitrogen (%) | 0.06 |
| Available potassium (ppm) | >331 |
| Available phosphorus (ppm) | > 23 |

The experiment was tested under randomized block design (RBD) with three replication and 6 treatments. The strawberry runners were planted during the last week of October, 2014. The planting materials were collected from M/s Beniwal strawberry Research Farm, New Delhi, India during the last week of October, 2014. Recommended dose of vermicompost and *Azotobacter* were applied at the rate of 100 q/ha, and 30 ml/L water, respectively. Vermicompost broadcasted in the tested plots and mixed well with the soil before the planting of runners. Vermicompost were applied at

the rate of 1.62 kg (100 %), 1.21 kg (75 %), 0.81 kg (50 %), 0.40 kg/plot (25 %) and *Azotobacter* was applied by dipping of strawberry runners in 30 ml per litre water (100 %), 22.5 ml per litre (75 %), 15 ml per litre (50 %) and 7.5 ml per litre water (25 %) for 20 minutes just before the planting.

Various intercultural operations viz. weeding, hoeing etc. were done frequently for better growth and development of plants and for yield as well. Straw mulch applied around the plants that help in moisture conservation and also to restrict the weed population. For providing proper moisture to the plants frequent irrigation applied at weekly interval. Plant protection measures were also applied during the cropping period.

The fruits of Strawberry were harvested at an interval of 3-4 days during cool morning hours at commercial maturity when >80% of the fruit surface turned red colour.

Observations were recorded on various quality parameters of strawberry fruits i.e. Total soluble solid (TSS), titratable acidity, reducing sugar, total sugars, vitamin-C, pectin, anthocyanin and vitamin-A. TSS ($^{0}$Brix) of fresh strawberry fruits was measured with the help of Erma Hand Refectometer. Titratable acidity (%), reducing sugar (%), total sugars (%), vitamin-C (mg/100g), pectin (%), anthocyanin (IU/100 g) and vitamin-A (IU/100 g**)** were estimated as per method suggested by Ranganna (1997). Total soluble solids: acid and total sugars: acid ratio was worked out by dividing TSS and total sugars by titratable acidity in each replication, respectively. Statistical analysis of the data was carried out by the method of analysis of variance as per the method of Gomez and Gomez (1984).

## RESULTS AND DISCUSSIONS

The result of present study "effect of vermicompost and *Azotobacter* on quality parameters of strawberry (*Fragaria* × *ananassa* Duch.) Cv.Sweet Charlie" is presented in Table-2 and Figure 1 (A–J). maximum total soluble solid (10.73 $^{0}$Brix), titratable acidity (0.74 %), reducing sugar (4.49 %), total sugars (6.39 %), vitamin-C (69.33 mg/100g), pectin (0.57 %), anthocyanin (58.55 IU/100 g) and vitamin-A (60.00 IU/100 g) were recorded in $T_4$ followed by $T_5$ (10.40 $^{0}$Brix TSS), (0.70 % titratable acidity), (4.47 % reducing sugar), (6.19 % total sugars), (64.67 mg/100 g vitamin C), (0.57 % pectin), (58.55 IU/100 g anthocyanin). Highest TSS: Acid ratio (17.05) and sugar: acid ratio (10.15) was recorded in $T_5$ followed by $T_4$.

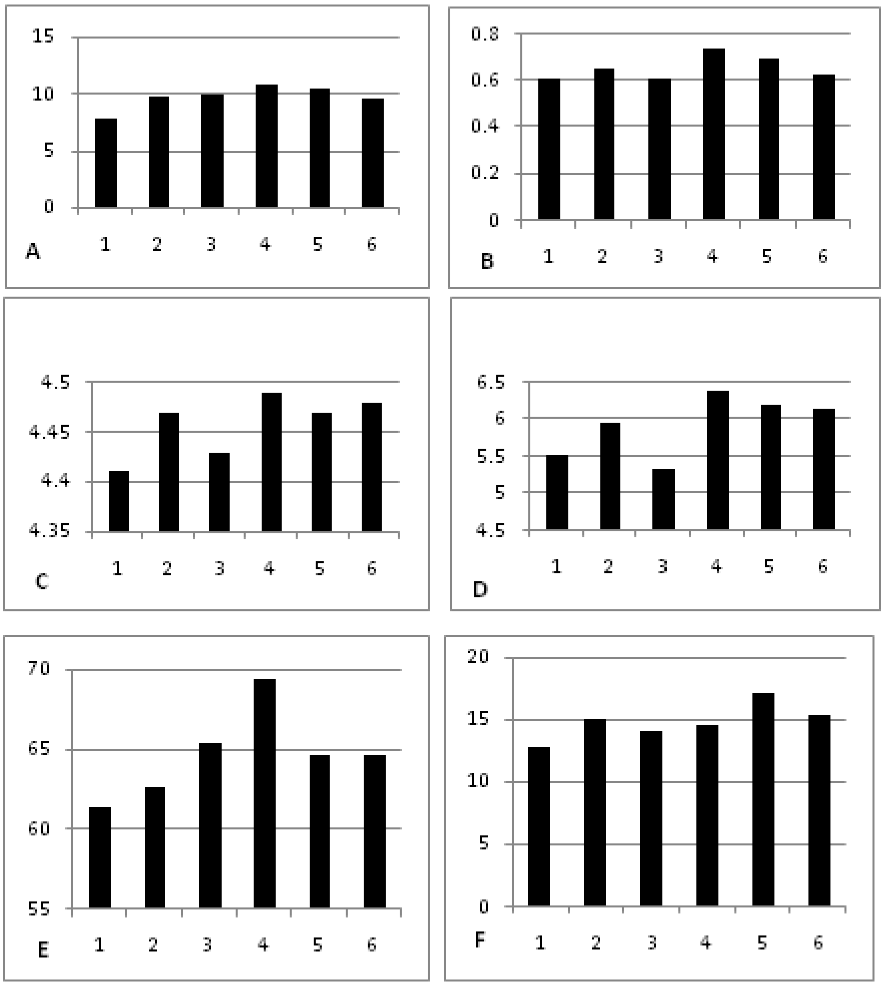
The fruits with maximum contents of soluble solids, titratable acidity, reducing sugar, total sugars, vitamin-C, pectin and anthocyanin, harvested from plots those were treated with Vermicompost (75%) + *Azotobacter* (25%) ($T_4$) followed by $T_5$ (vermicompost 50% + *Azotobacter* 50%) which may be due to higher concentration of Vermicompost (75%) along with *Azotobacter* (25%) as vermicompost are hydrophilic nature and absorbed moisture and nutrients which persist longer thus improving the soil structure and indirectly enhancing fruit quality and ascorbic acid contents. Hence, these findings are accordance with those of (Wang and Lin, 2002, Aroncon *et al*., 2004, Singh *et al*., 2010 and Ayesha *et al*., 2011). Increased TSS and total sugars in berry with the application of *Azotobacter* and vermicompost may be attributed due to the quick metabolic transformation of starch and pectin into soluble compounds and rapid translocation of sugars from leaves to the developing fruits. These findings are in agreement with the results of Singh and Singh, (2006); Haynes and Goh (1987); Singh et al. (2008) in strawberry; Rathi and Bist (2004) in pear and Baksh et al. (2008) in guava. Theunissen et al. (2010) reported that the use of vermicompost due to its large amounts of humic can cause the synthesis of phenolic compounds such as flavonoids and anthocyanins. Saeedi (2001) reported that vermicompost increased the amount of anthocyanin in Lilium flowers. Badr et al. (2003) reported that sugar is produced by breaking the starch in the leaves and

Anthocyanins will also increases with increasing glucose levels due to cell metabolism, resulting in the accumulation of soluble sugars in the cell.

**Table 2: Effect of Vermicompost and *Azotobacter* on Quality Parameters of Strawberry Cv. Sweet Charlie**

| Treatments | TSS (°Brix) | Titratable Acidity (%) | Reducing Sugar (%) | Total Sugars (%) | Vitamin-C (Mg/100g) | TSS: Acid Ratio | Sugrs: Acid Ratio | Pectin (%) | Anthocyanin (IU/100g) | Vitamin-A (IU/100g) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Control** | 7.83 | 0.61 | 4.41 | 5.52 | 61.33 | 12.84 | 9.05 | 0.52 | 55. 16 | 57.33 |
| **VC (100 %)** | 9.73 | 0.65 | 4.47 | 5.97 | 62.67 | 14.97 | 9.18 | 0.56 | 55. 22 | 59.67 |
| **AZO (100%)** | 9.87 | 0.61 | 4.43 | 5.33 | 65.33 | 14.10 | 7.61 | 0.54 | 57.77 | 58.67 |
| **VC (75%) + AZO (25%)** | 10.73 | 0.74 | 4.49 | 6.39 | 69.33 | 14.50 | 8.64 | 0.57 | 58.55 | 60.00 |
| **VC (50%) + AZO (50%)** | 10.40 | 0.70 | 4.47 | 6.19 | 64.67 | 17.05 | 10.15 | 0.57 | 58.55 | 58.67 |
| **VC (25%) + AZO (75%)** | 9.67 | 0.63 | 4.48 | 6.14 | 64.67 | 15.35 | 9.75 | 0.54 | 57.77 | 58.33 |
| **SEm ±** | 0.10 | 0.11 | 0.028 | 0.64 | 1.38 | 0.32 | 0.22 | 0.53 | 0.18 | 0.32 |
| **CD at 5%** | 0.31 | 0.34 | NS | 0.20 | 4.36 | 0.17 | 0.72 | 0.16 | 0.58 | 1.03 |

**VC= Vermicompost; AZO= *Azotobacter***



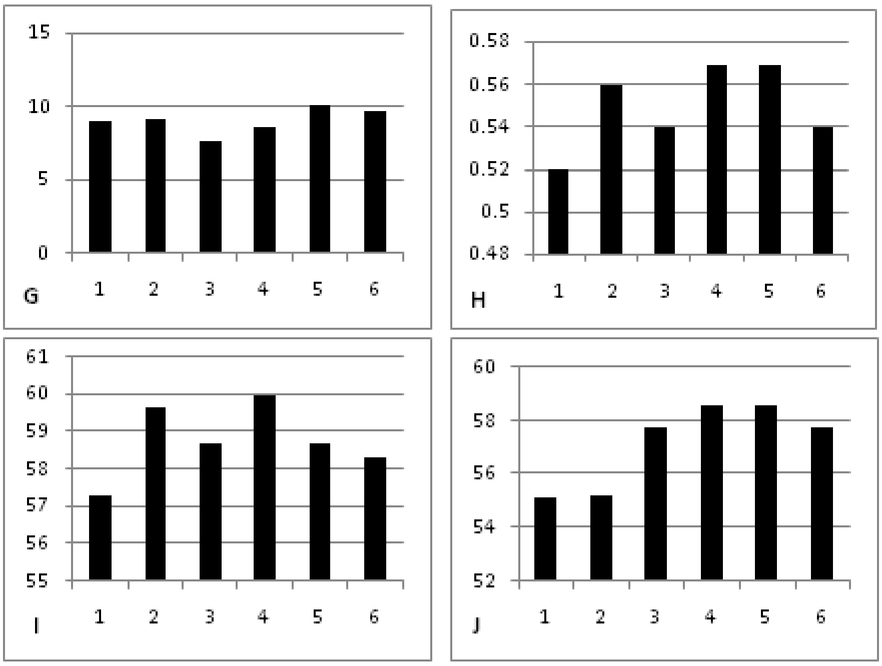



**Figure 1: Effect of Vermicompost And *Azotobacter* on (A) TSS (B) Titratable Acidity (C) Reducing Sugar (D) Total Sugars (E) Vitamin C (F) TSS: Acid Ratio (G) Total Sugars: Acid Ratio (H) Pectin (I) Vitamin A (J) Anthocyanin**

## REFFERENCES


1. Arancon, N.Q., Edwards, C.A., Bierman, P., Welch, C. & Metzger, J. D. (2004). Influences of vermicomposts on field strawberries. I. Effects on growth and yields. Bioresource Technology. 93: 145-153.

2. Arancon, N.Q., Edwards, C.A., Lee, S. & Byrne, R. (2006). Effects of humic acids from vermicomposts on plant growth. European Journal of Soil Biology. 46:65-69.

3. Atiyeh, R. M., Lee, S., Edwards, C. A., Arancon, N. Q., & Metzger, J. D. (2002). The influence of humic acids derived from earthworm-processed organic wastes on plant growth. Bioresorce Technology. 84: 7–14.

4. Ayesha, R.N., Fatima, M., Ruqayya, K., Qureshi, M., Hafiz, K. S. Khan & Kamal, A. (2011). Influence of different growth media on the fruit quality and reproductive growth parameters of strawberry. Journal of Medicinal Plant Research. 5(26):6224-6232.

5. Badr, A.C., Genet, P., Dunand, F.V., Toussaint, M.L., Epron, D.A, & Badot, P.M. (2003). Effect of Copper on growth in Cucumber plants and its relationships with carbohydrate accumulation and change in ion contents. Jounal Plant Science. 166: 1213 – 1218.

6. Baksh, H., Yadav, R. & Dwivedi, R. (2008). Effect of INM on growth, yield attributing characters and quality of guava cv Sardar. Progressive Agriculture. 8(2): 141-144.

7. Bescking, J.H. (1961). Studies on nitrogen-fixing bacteria of the genus Beijerinckia. I. geographical and ecological distribution in soil. Journal of Plant Soil 14: 49-81.

8. Burris, R.H. (1969). Progress in the biochemistry of nitrogen fixation. Proc. Royal Soc. London B. Biological Science. 172: 339-354

9. Childer, N.F., Morris, J.R. & Sibbett, G.S. (1995). Modern Fruit Science. HorticulturePublication, Gainsville, Florida, U.S.A.

10. Gomez, A.A. & Gomez, K.A. (1984). Statistical Procedures for Agricultural Research, pp 680. John Willey and Sons, Inc. New York.

11. Haynes, R.J. & Goh, K.M. (1987). Effect of nitrogen and potassium applications on strawberry growth, yield and quality. Communications in Soil Science and Plant Analysis 18: 457-471.

12. Jackson, M.L. (1962). Soil Chemical Analysis. Prentice Hall Inc, USA.

13. Jensen, H.L. (1965). Non-symbiotic nitrogen fixation. In: Soil nitrogen (Eds.: W.V. Bartholomew and F.E. Clark). American Society of Agronomy, Monograph No 10. Madison, Wisconsin. pp. 440-485.

14. Karakara, B.K. & Dwivedi, M.P. (2002). Strawberry. In. Enhancement of temperate fruit production–In changing climate (Eds. K.K. Jindal and D.R. Gautam) Solan, UHF: 198-204.

15. Larson, K.D. (1994). Strawberry (In): Handbook of environmental physiology of fruit crops 1:

16. Olsen, S., Watanabe, F. S. & Bowman, R.A. (1983). Evaluation of fertilizer phosphate residues by plant uptake and extractable phosphorus. Soil Science Society of American journal. 47: 952–958.

17. Pramanik, P., Ghosh, G. K., Ghosal, P. K., & Banik, P. (2007). Changes in organic-C, N, P and K and enzyme activities in vermicompost of biodegradable organic wastes under liming and microbial inoculants. Journal of Bioresorce Technology. 98: 2485-2494

18. Pramanix, B. N. & Misra, A.N: (1955). Effect of continuous manuring with artificial fertilizers on Azotobacter and soil fertility. Indian Journal of Agricultural Science. 25: 1-13.

19. Ramasamy, P.K. & Suresh, S.N. (2011). Effect of vermicompost on root numbers and length of sunflower plant (Helianthus annuus L.). Journal of pure and applied microbiology. 4(1): 297-302

20. Ranganna, S. (1997). Handbook of analysis and Quality control of fruit and vegetable products.2nd end, pp 190-210.Tata Mcgrow Hill Publishing co., New Delhi.

21. Rathi, D. S. & Bist, L.D. (2004). Inorganic fertilizers through the use of organic supplements in low chill pear cv. Pant Pear- 18. Indian Journal of Horticulture 61 (3): 223-225.

22. Saeedi, F (2001). The effect of different levels of vermicompost on the qualitative and quantitative indicators of Lilium flowers varieties (Nello, Tresor, Navona), MS Thesis, Azad University Branch of Garmsar.

23. Sharma, R.M. & Yamdagni, R. (2000). Modern strawberry cultivation. Ludhiana, India, Kalyani Pub 37 (1):163-165.

24. Singh, A. & Singh J. N. (2006) Studies on influence of bio fertilizers and bio-regulators on flowering, yield and fruit quality of strawberry CV. Sweet Charley. Annals of Agricultural Research 27: 261-264.

25. Singh, R., Sharma, R.R., S, Kumar. Gupta, R.K. & Patil, R.T. (2008).Vermicompost substitution influences growth, physiological disorders, fruit yield and quality of strawberry (Fragaria × ananassa Duch.). Bio resource Technology 99, 8507-8511

26. Singh,R.R., Sharma, R., Kumar, S., Gupta, R.K., Ashrey, R., Kumar,A., & Jangra, K.K.(2010). Sequential foliar application of vermicompost leachates improves marketable fruit yield and quality of strawberry (Fragaria x ananassa Duch.) Science Horticulture. 124: 34-39.
27. Stanford, G. & Smith, S. J. (1978). Oxidative release of potentially mineralizable soil nitrogen by acid permanganate extraction. Soil Science. 126: 210–218
28. Theunissen, J.P, Ndakidemi, A. & Laubscher, C.P. (2010). Potential of vermicompost produced from plant waste on the growth and nutrient status in vegetable production. International Journal of the Physical Sciences. 5(13): 1964-1973.
29. Wang, S.Y., & Lin, S. (2002). Composts as soil supplement enhanced plant growth and fruit quality of strawberry. Journal o Pflant Nutrition. 25: 2243-2259.